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EDITORIAL

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Open Access journals need to become first choice, in invasion ecology and beyond

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Open Science is a pivotal global movement to advance science and scholarship. It includes key elements such as Open Access to scientific publications, Open Data, Open Source, and Open Methodology (Kraker et al. 2011; McKiernan et al. 2016; Stodden et al. 2016), and therefore fosters reproducibility and verification of findings (Wilkinson et al. 2016). Scientific knowledge, the product of research, is a public good and should thus be made publicly available. The vast majority of researchers agree with the idea of Open Science (Dallmeier-Tiessen et al. 2011), yet many face challenges in implementing Open Science in practice.

Here we highlight one of these challenges, using invasion ecology as a case example. Consider a typical situation in many research projects: your collaborator, PhD student, or postdoc discovers new research results and approaches you to discuss where to publish the work. You both know that impact factors (IFs) are flawed (e.g. San Francisco Declaration on Research Assessment, DORA, http://www.ascb.org/dora). The IF of a journal does not allow one to assess the quality of an individual paper, and there seems to be an increasing commitment by the scientific community

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not to use the IF when evaluating people or institutions. Indeed, the authors of this article strongly support the DORA declaration. At the moment, though, IFs are still frequently used by hiring and grant committees to evaluate researchers (McKiernan et al. 2016; Tregoning 2018). To be on the safe side, you'd like to publish your best work in high-impact journals. Given that you want to promote Open Science, and perhaps your research institution or the organization funding your work requires publication in Open Access (OA) journals, you look for a high-impact OA journal as first-choice outlet for the exciting results.

You may consider three options, (i) multidisciplinary, (ii) ecology, or (iii) invasion ecology journals, and use the latest Journal Citation Report by Clarivate Analytics to prepare a list of potential target journals, comparing OA with subscription journals (Table 1). You are not sure yet if you want to go for the classic multidisciplinary flagship journals "Nature" or "Science", where rejection rates are very high, but you notice that both publishers of these journals, Springer Nature and AAAS, have launched OA journals with the same general scope as their flagship journals. These journals, "Nature Communications" and "Science Advances", have high IFs, too, but they are markedly lower than those of "Nature" and "Science". Clearly, "Nature Communications" and "Science Advances" are very good outlets, but from an IF perspective only second choice after "Nature" and "Science". In addition, "Nature Communications" and "Science Advances" are the only OA journals in the top-10 of journals, based on IF, that sometimes publish papers related to biological invasions (Table 1A).

In the discipline of ecology, the 2018 Journal Citation Report (JCR) lists 164 journals, of which the subscription journal "Trends in Ecology & Evolution" has the highest IF (15.2; Table 1C). Only 23 OA journals (14.0%) are currently included for this discipline, with "Ecology and Society" having the highest IF (4.14; ranking 29 among all journals in ecology). Thus, there is currently no OA top-tier journal in ecology (Fig. 1; cf. Barbaro et al. 2015).

When focusing on specialist journals in the field of invasion ecology itself, the picture looks different. Here, four of the five journals that we consider as invasion ecology journals are OA (Table 1E). This is probably because these journals are rather young in the general field of ecology. Nonetheless, the single subscription journal focusing on invasion ecology, i.e. the journal "Biological Invasions", currently has the highest IF in the field; "NeoBiota" follows on the second place.

Why are there only few top-tier OA journals?

Most of the prominent subscription journals have existed for a much longer time period than OA journals. This is one obvious explanation why high-impact OA journals are currently lacking in invasion ecology and most other disciplines: OA journals simply have not had the time to build a reputation (although counterexamples such as "eLife" exist, see Table 1B, primarily through major financial support and promotion by leading research organizations, such as the Howard Hughes Medical Institute, the

Table 1. Top 10-impact factor journals included in Clarivate Analytics' 2018 Journal Citations Report (JCR): (A) all journals that, at least sometimes, publish invasion ecology articles (these journals are relevant to invasion ecologists); (B) Open Access journals that, at least sometimes, publish invasion ecology articles; (C) journals in JCR's category "Ecology"; (D) Open Access journals in JCR's category "Ecology"; (E) journals specialized in invasion ecology; (F) Open Access journals specialized in invasion ecology. In A-F, Open Access journals are highlighted in bold.

A) All relevant journals		B) Relevant Open Access journals	
Nature	43.1	**Sci. Adv.**	12.8
Science	41.0	**Nat. Commun.**	11.9
Nat. Clim. Change	21.7	**PLOS Biol.**	8.39
Trends Ecol. Evol.	15.2	**eLife**	7.55
Sci. Adv.	12.8	**Conserv. Lett.**	7.40
Nat. Commun.	11.9	**BMC Biol.**	6.72
Nat. Ecol. Evol.	11.0	**Sci. Data**	5.93
Front. Ecol. Environ.	10.9	**Ecol. Soc.**	4.14
Annu. Rev. Ecol. Evol. Syst.	10.9	**Sci. Rep.**	4.01
Biol. Rev.	10.3	**BMC Plant Biol.**	3.95
C) Ecology journals		D) Open Access ecology journals	
Trends Ecol. Evol.	15.2	**Ecol. Soc.**	4.14
Nat. Ecol. Evol.	11.0	**Biogeosciences**	3.95
Front. Ecol. Environ.	10.9	**Mov. Ecol.**	3.75
Annu. Rev. Ecol. Evol. Syst.	10.9	**Conserv. Physiol.**	3.63
ISME Journal	9.49	**Glob. Ecol. Conserv.**	2.75
Global Change Biol.	8.88	**Ecosphere**	2.75
Ecol. Lett.	8.70	**Front. Ecol. Evol.**	2.69
Ecol. Monogr.	7.70	**NeoBiota**	2.49
Methods Ecol. Evol.	7.10	**Ecol. Evol.**	2.42
Mol. Ecol. Resour.	7.05	**BMC Ecol.**	2.38
E) Invasion ecology journals		F) Open Access invasion ecology journals	
Biol. Invasions	2.90	**NeoBiota**	2.49
NeoBiota	2.49	**Aquat. Invasions**	1.71
Aquat. Invasions	1.71	**Manag. Biol. Invasion**	1.52
Manag. Biol. Invasion	1.52	**BioInvasions Rec.**	1.20
BioInvasions Rec.	1.20		

Max Planck Society, and the Wellcome Trust). 42% of the respondents to the SOAP project survey (Dallmeier-Tiessen et al. 2011) who indicated to not have published OA articles wrote they had specific reasons for it. One of the two most recurring reasons was: "OA journals are perceived/assumed not to be of good quality or they do not have an impact factor" (Dallmeier-Tiessen et al. 2011). This or a similar response related to journal quality was given by 30% of the respondents.

We would like to highlight another reason for the lack of high-impact OA journals that is often overlooked: As shown above, OA journals are frequently implemented as a second-choice option by publishers. Although new OA journals can become high-impact journals (see e.g. "PLOS Biology" or "eLife"), such a trajectory is hampered by publishers that offer authors of manuscripts rejected in their first-choice journals the option to transfer the work to an in-house OA journal. This is, for example, done by Wiley: "A number of Wiley Open Access journals participate in a Manuscript Transfer

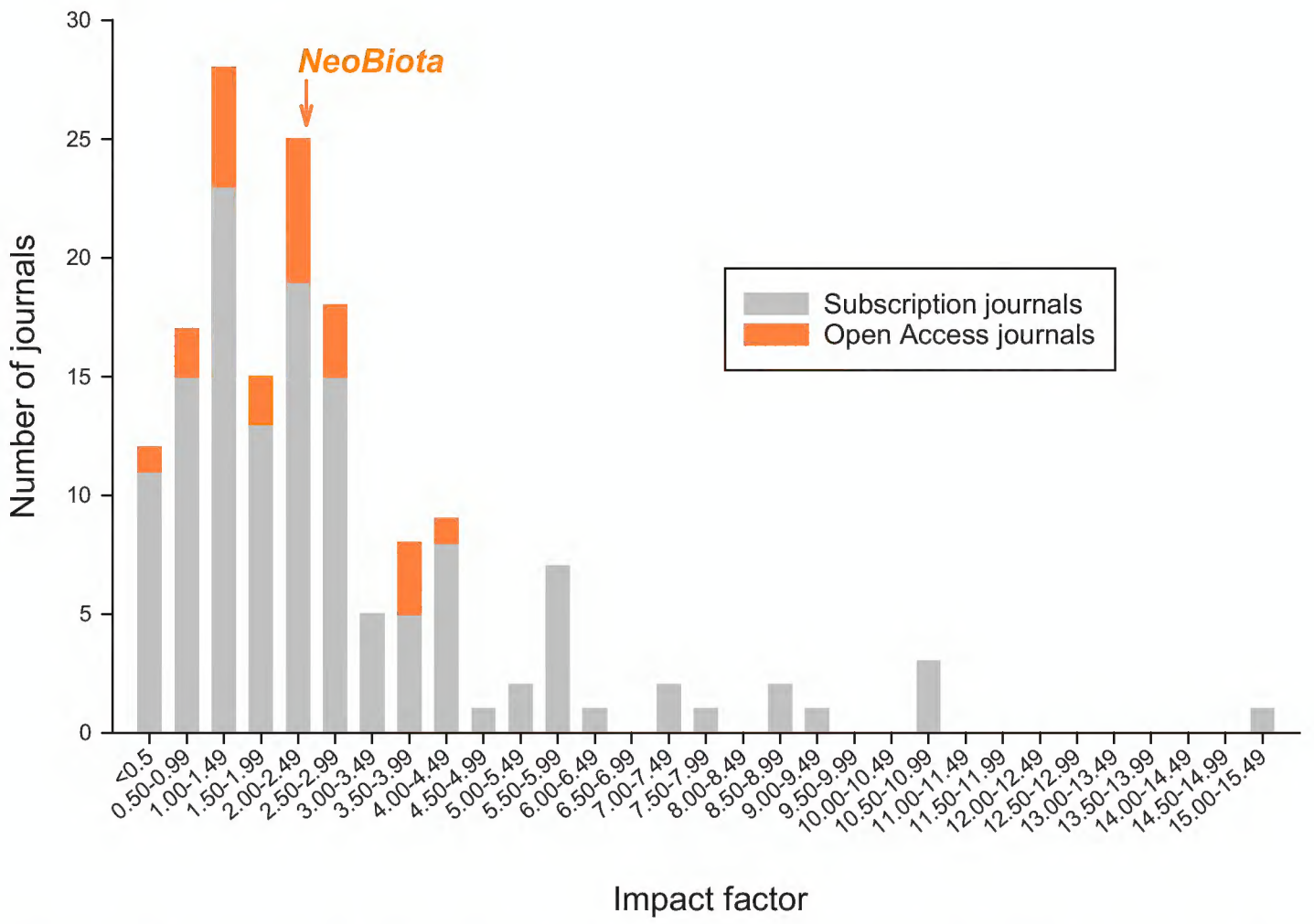

Figure 1. Distribution of 2018 journal impact factors in JCR's category "Ecology" (cf. Table 1C). "NeoBiota" is shown separately. The median and mean impact factor of Open Access journals in JCR's category "Ecology" is 2.08 and 2.12 (n = 23), respectively; for subscription journals, the median is 2.31 and mean 2.84 (n = 141). Thus, while the IF between Open Access and subscription journals does not strongly differ on average, there is a critical lack of Open Access journals with high impact factors—these are the journals where researchers aim to publish their best papers and that they highlight in their CVs.

Program. After review in a supporting journal, rejected articles of suitable quality can be identified by the Editor as candidates for publication in a Wiley Open Access journal" (https://authorservices.wiley.com/open-science/open-access/about-wiley-open-access/manuscript-transfer-program.html, accessed 29 August 2019). For example, manuscripts rejected by Wiley subscription journals such as "Global Change Biology", "Global Ecology and Biogeography", or the "Journal of Biogeography" can be transferred to the OA journals "Ecology and Evolution" or "Geo: Geography and Environment". Other publishers, e.g. Springer Nature (see above), and even some learned societies, e.g. AAAS (see above) and the Ecological Society of America, follow similar manuscript transfer policies, at least for some of their journals. These policies are considered a business model for publishers, taking benefit from efforts already spent on a submitted manuscript (e.g. internal and external review processes). They are also signalling authors that their subscription journals are first choice, whereas OA journals are second choice. They are nudging researchers to first submit to subscription journals and only later to OA journals.

Publishers might also be doing so to maximize profit via "double-dipping" (Barbaro et al. 2015). They receive money from libraries for subscribing to journals, and they receive additional money if publications are made OA in such subscription journals (Hybrid Open Access). Researchers who place their best work in high-impact journals (that are not OA) pay to make them OA, and publishers maximize their profit. Learned societies are in a bind right now (Brainard 2019). Their budgets typically depend on income generated through contracts with publishers, and these contracts are much more lucrative for subscription journals.

What are possible ways forward?

We identified five possible ways forward. First, publishers should make their classic flagship journals OA, rather than launching second-choice OA outlets. This could work if research foundations require their grant holders to openly publish their results. The Gates Foundation has such a requirement since 2017, and two prestigious subscription journals, "The New England Journal of Medicine" and "Proceedings of the National Academy of Sciences USA", responded by offering Gates grant holders to publish their papers in these journals OA (Van Noorden 2018). European funding agencies that have formed the cOAlition S follow the Gates foundation in requiring OA publication by 2021; this initiative is called "Plan S" and has been pushed forward by the Open Access Envoy of the European Commission, the President of Science Europe, a group of heads of national funding organisations (including the senior author of this article) and the Scientific Council of the European Research Council (Schiltz 2018; https://www.coalition-s.org/). Further, given that journals are largely run by us researchers, we can directly ask publishers to switch a subscription journal to an OA journal without too expensive publication costs. If publishers decline to do so, an option would be to follow the former editors of the subscription journal "Lingua" who left the publisher Elsevier and re-established the journal under the new name "Glossa" as an OA outlet. As authors and reviewers, we can also boycott publishers by not submitting manuscripts to their journals or not reviewing for them (http://thecostofknowledge.com).

Second, publication costs in OA journals must become reasonable. Traditional scientific publishing has not only been criticized because of the paywall of subscription journals, but also because publishing houses have made a fortune with a product that is largely paid by taxpayers; these usually pay the scientists, including their equipment, to (i) do the research, (ii) write the manuscripts, and (iii) review and edit other manuscripts. Outrageous profit margins of publishers have been a key point in the critique against traditional publishing (e.g. Van Noorden 2013). If we now turn subscription journals into OA journals (point 1 above), but do not reduce the profit margins of the big publishers, we have not yet reached what we are aiming for. "Science Advances" and "Nature Communications", i.e. the top-two OA multidisciplinary journals (cf. Table 1B), currently charge US$ 4500 or even US$ 5200 per article, respectively

(checked on 29 August 2019; cf. Van Noorden 2013). Even average charges for the three big publishers Springer Nature, Wiley, and Elsevier are between US$ 2100 to 3000 (https://treemaps.intact-project.org/apcdata/combined/#publisher/, checked on 29 August 2019). An interesting example is the case of "Diversity and Distributions", a Wiley journal that in 2019 switched from a subscription to an OA model (it is not counted as an OA journal in Table 1 and Fig. 1, as we followed the JCR's classification where the journal is still included as a subscription journal because the switch happened so recently). The decision to switch to OA was apparently taken by the publisher without consulting the journal's editorial board beforehand, and came along with a charge of US$ 2200 to publish in this journal in the future. As a result, many editors protested and left the journal (Peterson et al. 2019). Journals from publishers such as Pensoft, which publishes "NeoBiota", have considerably lower publication charges. In case of Platinum (also known as Diamond) Open Access, authors do not have to pay for their publications at all. Such a Platinum OA model is, for example, implemented for the Beilstein journals (financially supported by the Beilstein Institute) and "Web Ecology" (supported by the European Ecological Federation).

Third, those researchers who can afford to largely ignore impact factors (e.g. because they have a permanent position or a very high scientific standing) should submit their best work to OA journals even if these do not (yet) have a high reputation. If many colleagues do the same, the impact factor of such journals will rise, and so will their reputation.

Fourth, we must combat predatory journals which are typically OA and thus reduce the reputation of OA journals overall. The Directory of Open Access Journals (DOAJ; https://doaj.org) is a valuable source, as it lists high-quality OA journals and thus helps to discriminate those from purely profit-orientated predatory journals without any scientific quality control. The latter are reported at https://predatoryjournals.com, a follow-up of the well-known Beall's list which discontinued in 2017.

Fifth, learned societies should change their business plans, so that they can afford converting their journals to OA. The European Group on Biological Invasions, NEOBIOTA, changed its publication model to OA in 2011—this is the reason why the journal you read right now is OA. Similarly, the latest journal of the International Association of Vegetation Science, "Vegetation Classification and Survey", is OA as well. Learned societies could receive part of the OA publication fee (which is reduced for authors who cannot afford it and for society members). At the same time, learned societies bear particular responsibility and solidarity for scientists of the Global South, who lack the resources for many subscription journals. Indeed, we should not accept that they remain cut-off from the knowledge generated in wealthy countries. It is vital, however, that they are still able to publish their own work, that publication fees are not prohibitive (see above).

Eventually, subscription journals should disappear in science altogether. This is unrealistic in the very near future, but for example in Germany the project DEAL (https://www.projekt-deal.de) reached a three-year agreement with the publisher Wiley, allowing all members of project DEAL institutions to access Wiley publications back to 1997, and to publish OA articles in Wiley's journals with no addi-

tional charge: the annual fee paid at the national level releases libraries at all project-DEAL institutions from paying additional subscription charges, and researchers in these institutions do not have to pay additional charges to publish OA papers in Wiley's journals (Sander et al. 2019). A major aim of the project DEAL is to make all publications submitted from German research institutions OA. Although negotiations with Elsevier are currently stuck (but see a recent agreement in Norway), a memorandum with Springer Nature was signed this August to make an agreement similarly to the one with Wiley (https://www.projekt-deal.de). If other countries follow, scientific journals will be effectively OA for all these countries. Indeed, the above-mentioned developments, e.g. "Plan S" that European research results should be exclusively published OA (Schiltz 2018; https://www.coalition-s.org/principles-and-implementation/), give hope that OA journals will become first choice—and that subscription journals will eventually disappear. As outlined above, though, we should keep in mind that a successful transition to OA publishing will crucially depend on fair pricing and quality control of OA journals.

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